

Pediatric Lead Exposure In Flint, Michigan: A Failure of Primary Prevention

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Introducing

Ex. 6 - Personal Privacy

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- 12 month old girl [Ex. 6 - Personal Privacy] presented last week for her 1 year old check up. No concerns.
- Lives with single mom and 2 older siblings in west side (48504). Formula from WIC; powder mixed with warm tap water.
- Physical exam and development are normal. [Ex. 6 - Personal Privacy] receives her 1 year old vaccines and routine lead and hemoglobin screening.
- *A couple days later, lead level comes back as 6 ug/dL.*

*Hypothetical scenario

Blood lead level of 6 ug/dL....

- Blood lead levels (BLL) above 5 ug/dL are considered elevated blood lead levels (EBL)
- Just a few years ago (2012), 10 ug/dL was cutoff
- Increasing evidence shows NO safe blood lead level
- Disproportionately impacts low income, minority children
- Primary prevention is most important

Primary Prevention

- “Because no measurable level of blood lead is known to be without deleterious effects, and because once engendered, the effects appear to be irreversible in the absence of any other interventions, public health, environmental and housing policies should encourage PREVENTION of all exposure to lead.”

“Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention.” 2012
CDC Advisory Committee on Childhood Lead Poisoning Prevention.

What will happen to

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- Vast evidence supports increased likelihood of:
 - Decrease in IQ
 - An increase in BLL from 1 to 4 ug/dL, drops mean IQ -3.7 points
 - Small change in mean IQ, shifts entire population IQ distribution
 - Reduces high achievers IQs (>130) and increases kids with low IQs (<70)
 - Implications for special education services, employment, incarceration, life achievement, etc

Lanphear BP et al., Low-level environmental lead exposure and children's intellectual function: an international pooled analysis. *Environ Health Perspect*, 2005. 113:894-9.
 Fewtrell LJ, Pruss-Ustun A, Landrigan P, and Ayuso-Mateos JL, Estimating the global burden of disease of mild mental retardation and cardiovascular diseases from environmental lead exposure. *Environmental Research*, 2004. 94:120-33.

Behavioral Burden

- Increased likelihood of :
 - ADHD behaviors
 - Delinquent behaviors and arrests
 - Total arrests and increased rates of arrests involving violent offenses
 - Other health effects: hematologic, cardiovascular, immunologic, endocrine, etc

Wright, JP, KN Dietrich, MD Ris, et al. 2008. Association of prenatal and childhood blood lead concentrations with criminal arrests in early adulthood. *PLoS Med* 5(5): e101
 Chen, A, B Cai, KN Dietrich, et al. 2007. Lead exposure, IQ, and behavior in urban 5-7 year-olds: Does lead affect behavior only by lowering IQ? *Pediatrics* 119(3): e650-e658.
 Needleman, HL, C McFarland, RB Ness, et al. 2002. Bone lead levels in adjudicated delinquents: A case control study. *Neurotoxicology and Teratology* 24(6):711-717.

The Cost

- “For childhood lead poisoning, \$5.9 million in medical care costs, as well as an additional \$50.9 billion (sensitivity analysis: \$44.8–\$60.6 billion) in lost economic productivity resulting from reduced cognitive potential from preventable childhood lead exposure.”
- “The present value of Michigan’s economic losses attributable to lead exposure in the 2009 cohort of 5 year-olds ranges from \$3.19 (using U.S. blood lead levels) to \$4.85 billion (using Michigan blood lead levels) per year in loss of future lifetime earnings.”

Leonardo Trasande and Yinghua Liu. Reducing The Staggering Costs Of Environmental Disease In Children, Estimated At \$76.6 Billion In 2008. *Health Affairs*, 30, no.5 (2011):863-870

The Price of Pollution: Cost Estimates of Environment-Related Childhood Diseases in Michigan. 2010 Report by Michigan Network of Children’s Environmental Health

Lead in Water

- Increasing as source of lead, because of success in controlling other sources.
- Increasing due to aging water infrastructures, change in water sources, disinfectant uses, etc
- Disproportionally impacts developmentally-vulnerable formula-fed infants and pregnant mothers
 - For about 25% of infants drinking formula made from tap water at 10 ppb, blood lead would rise above the CDC level of concern of 5 micrograms/deciliter (or ug/dL).
 - Increase in fetal death and reduced birth weights

Triantafyllidou, S., Gallagher, D. and Edwards, M. Assessing risk with increasingly stringent public health goals: the case of water lead and blood lead in children. *Journal of Water and Health*. doi: 10.2166/wh.2013.067 58-68 (2014).

Edwards, M. Fetal Death and Reduced Birth Rates Associated with Exposure to Lead-Contaminated Drinking Water. *Env. Sci. and Tech.* 2013 DOI: 10.1021/es4034952

Preliminary Results

Preliminary Results of Pediatric Blood Lead Levels (BLL)

- **Methods**
 - All children 5 years of age and younger
 - Zip codes 48501-48507
 - Two periods of comparison:
 - PRE-SWITCH: January 1, 2013 – September 15, 2013
 - POST-SWITCH: January 1, 2015 – September 15, 2015
 - Analyzed % Elevated Blood Lead (EBL)
 - EBL = Blood lead Levels > 5 g/dL

What was rest of county doing?

- Analysis of same time periods for Genesee County children who live outside of City of Flint zip codes (non 48501-48507)

Non-Flint results for children 5 years and under:

- PRE-SWITCH % EBL: 0.6%
- POST-SWITCH % EBL: 1.0%
- $p = 0.637$; NO CHANGE

Blood Lead Level Analysis

— % EBL all children less than 5 years of age

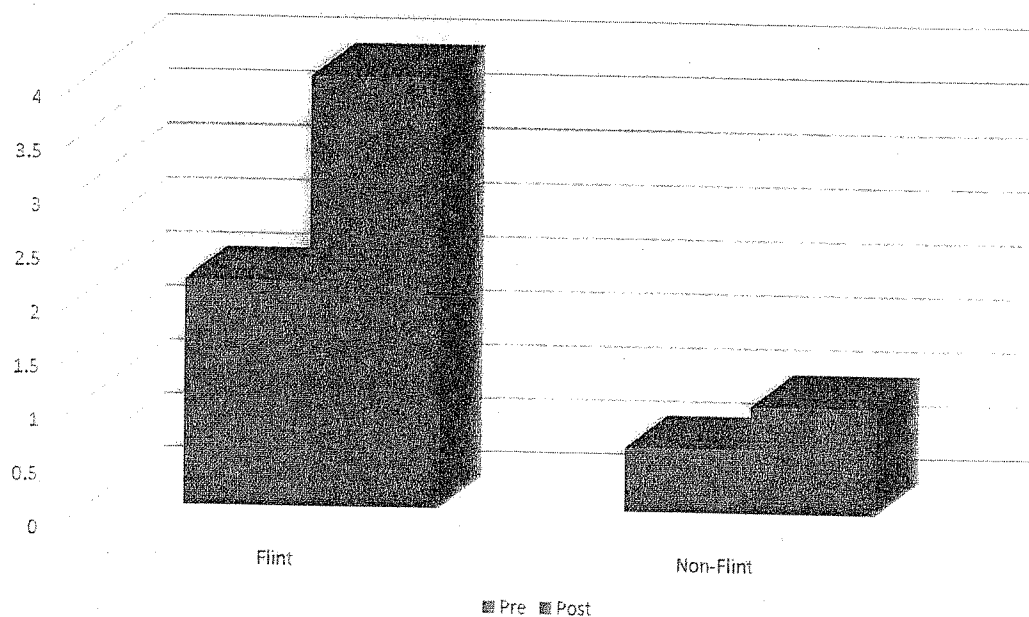
| | ALL FLINT (n=1746) | HIGH- RISK FLINT (n=742) | REST OF FLINT (n=1004) | NON- FLINT (n=1670) |
|-------------|--------------------------|-----------------------------------|------------------------------|---------------------------|
| PRE-SWITCH | 2.1% | 2.5% | 1.8% | 0.6% |
| POST-SWITCH | 4.0% | 6.3% | 2.4% | 1.0% |

Blood Lead Level Analysis

— % EBL children 15 months or less

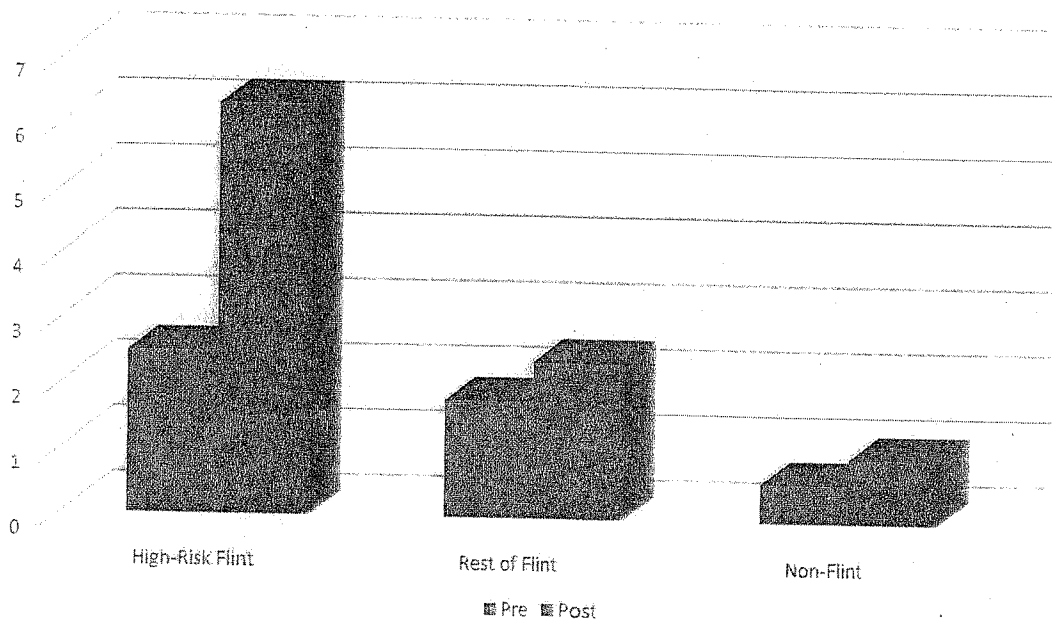
| | HIGH-RISK FLINT (n=269) | REST OF FLINT (n=350) | NON- FLINT (n=816) |
|-------------|-------------------------------|-----------------------------|--------------------------|
| PRE-SWITCH | 1.5% | 0.6% | 0.5% |
| POST-SWITCH | 4.4% | 1.1% | 0.5% |

Graphical Summary Change in % EBL Flint vs Non-Flint



Graphical Summary

Change in % EBL by area



Conclusions from BLL analysis

- % of children with EBL in Flint has increased
 - Most striking increase in zip codes with highest water lead levels
- Results underestimate risk: infants not screened for lead and water usage unknown.
 - *Accurate exposure largely unknown since national childhood lead screening focuses on household lead exposure (paint, soil, dust) at later ages (1 and 2 yrs)*
- Results are consistent and concerning. Primary prevention has failed.

Next Steps

- Immediately limit further exposure
 - Encourage breast feeding
 - No tap water for high risk groups: infants on formula & pregnant mothers
 - Declare health advisory: allows WIC to administer water or ready-to-feed formula and other resources (Salvation Army & United Way water supplies)
 - Distribution of lead clearing NSF-approved filters
 - Public education regarding precautions (flushing, etc)
 - Re-connect to Lake Huron water source ASAP

And

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- Asymptomatic now
- But what will her future hold and an entire generation of Flint children?

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